Space Weather Technical Forecast

Issued on Saturday 26 October 2024 at 13:02 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: M-flares likely, slight chance of further X-flares. Chance of G1-G2/Minor-Moderate geomagnetic storm intervals day 1 (26 Oct).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity had been Low for much of the past 24 hours but became High following a recent, multi-part, flare from the region of AR3872/AR3873. This flare beginning shortly before 26/0600 UTC and peaked at X1.8.

There are currently twelve primary sunspot regions on the disc with AR3870 attributed to the recently re-emerged region in the southwest disk and AR3871 to a small region in the southeast. Much of the sunspot activity lies in the southeast of the disc, with three notable regions located here. These are (from west to east) AR3869, AR3872, and AR3873. AR3869 comprises of mature penumbra around both leading and trailing regions, but with limited evolution. Similarly AR3872 evolves only slowly, but retains a delta configuration in the leading and perhaps also trailing portion of the group. AR3873, near the east limb is rotating into clearer view though only minor spot proliferation is apparent. AR3876, also in the southeast demonstrated the largest growth during the period with the emergence of small spots in its lead and trailing regions. Most other regions on the disc are smaller but multiple regions showing gradual development and a general increase in sunspot activity.

Assessment and modeling ongoing into the large CME associated with the X1.8 flare for any potential Earth directed component.

Solar Wind / Geomagnetic Activity: Solar winds observed by ACE at L1, were at Slow-ambient speeds, generally varying between 310-340km/s. Density was Below Average to Average. The Interplanetary Magnetic Field (IMF) remained Weak for much of the period, between 4-7nT, but showed a sharp increase to a peak of 14nT from 26/1134 UTC and has remained at Moderate levels to end the period. The north-south component, Bz, was generally Weak throughout, though became Moderately positive following the peak in Bt, reaching +9nT. Phi angle was mainly negative (towards the Sun). Geomagnetic activity was Quiet (Kp 0-2).

Energetic Particles / Solar Radiation: High energy proton flux observed by GOES18 was below S1 levels. High energy electron flux (greater than 2MeV) observed by GOES16 remained at mainly Background. The associated 24-hour fluence was well below the Active threshold, with 1.71e6 integrated flux observed at 26/0000UTC.

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Space Weather Technical Forecast

Four-Day Space Weather Forecast Summary

Solar Activity: Generally Moderate activity is expected, with occasional M-class flares considered likely and a slight chance of X-class flares, most probable from the numerous active regions in the southeast disc.

Solar Wind / Geomagnetic Activity: A CME resulting from the X3.3 of AR3869 on 24 Oct has been remodelled as a potential glancing impact at Earth on day 1 (26 Oct), perhaps recently observed at L1. This may combine with one or more weak CMEs that left the Sun on 22/23 Oct which have a small chance of a glancing impact, also on day 1 (26 Oct).

Solar winds are currently at Background levels but may become Slightly Elevated to Elevated during day 1 into day 2 (26-27 Oct) with potential fast wind and glancing CME influence. A return to mainly Background winds is currently expected into days 3 and 4 (28 and 29 Oct).

Activity is expected to be generally Quiet to Active on day 1 (26 Oct) with a chance of peak G1/Minor to G2/Moderate Storm conditions should geomagnetic conditions be favourable following any CME arrival. Activity should be Quiet to Active on day 2 (27 Oct), with perhaps a slight chance of G1/Minor Storm conditions at first. From day 3 (28 Oct) onward activity should return to Quiet to Unsettled levels.

Energetic Particles / Solar Radiation: High energy proton flux at GOES18 is expected to remain generally at Background. High energy electron flux at GOES16 is forecast to remain at mainly Background levels, with the associated 24 hour fluence remaining well below the Active (1e8 integrated flux) threshold.

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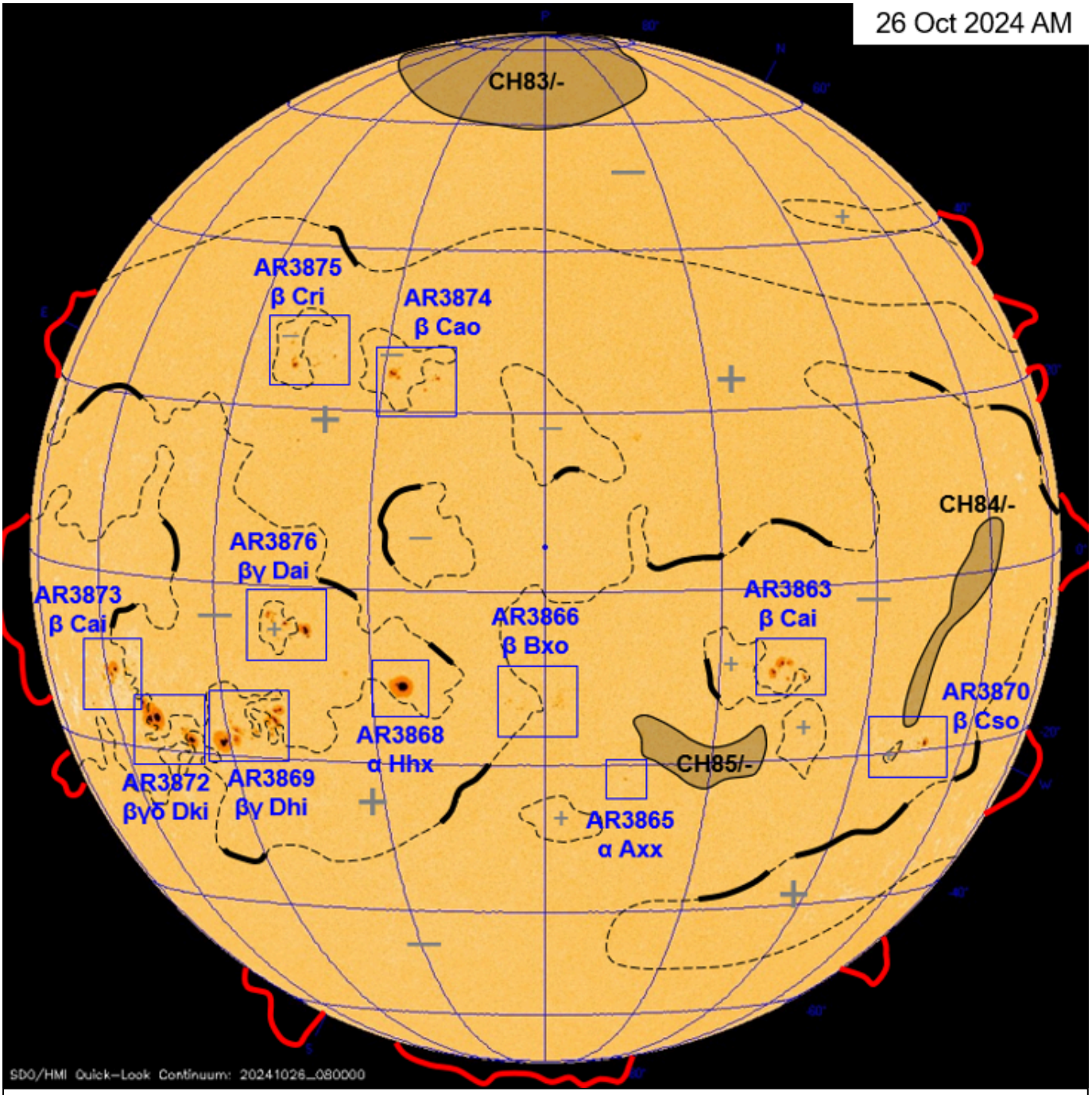
Figure 1: Solar Synoptic Map Valid 26/0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms

A number of weak CMEs from 22/23 Oct have been modeled to miss Earth, although there remains a small element of uncertainty in the nature of the CME observed around 23/1200UTC in the southeast disc and the potential for an Earth-directed component and glancing blow on day 1 (26 Oct). The main CME currently of note for the forecast period is from the X3.3 flare of AR3869 at 24/0357 UTC. The CME originated from the far southeast disc, but a flanking impact is possible on day 1 (26 Oct) following remodeling of this feature and likely recently observed at L1. This CME may also may sweep up the previously mentioned CMEs.

Solar winds are currently at Background levels. Some onset of a fast wind from CH84/- is likely during day 1 (26 Oct) with speeds perhaps peaking at Slightly Elevated or Elevated levels based on recurrence, before waning through day 2 (27 Oct). It is possible that CME influence may mask this enhancement however with a chance that speeds may peak towards Elevated to Strong levels following any more significant arrival. A return to mainly Background winds is currently expected into days 3 and 4 (28 and 29 Oct).

Activity is expected to be generally Quiet to Active on day 1 (26 Oct) with a chance of peak G1/Minor to G2/Moderate Storm conditions should geomagnetic conditions be favourable following any CME arrival. Activity should be Quiet to Active on day 2 (27 Oct), with perhaps a slight chance of G1/Minor Storm conditions at first. From day 3 (28 Oct) onward activity should return to Quiet to Unsettled levels, although further flare and CME activity from the numerous active regions in the southeast disc could change this.

Geomagnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	30	10	5	5
Strong	G3	No	5	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

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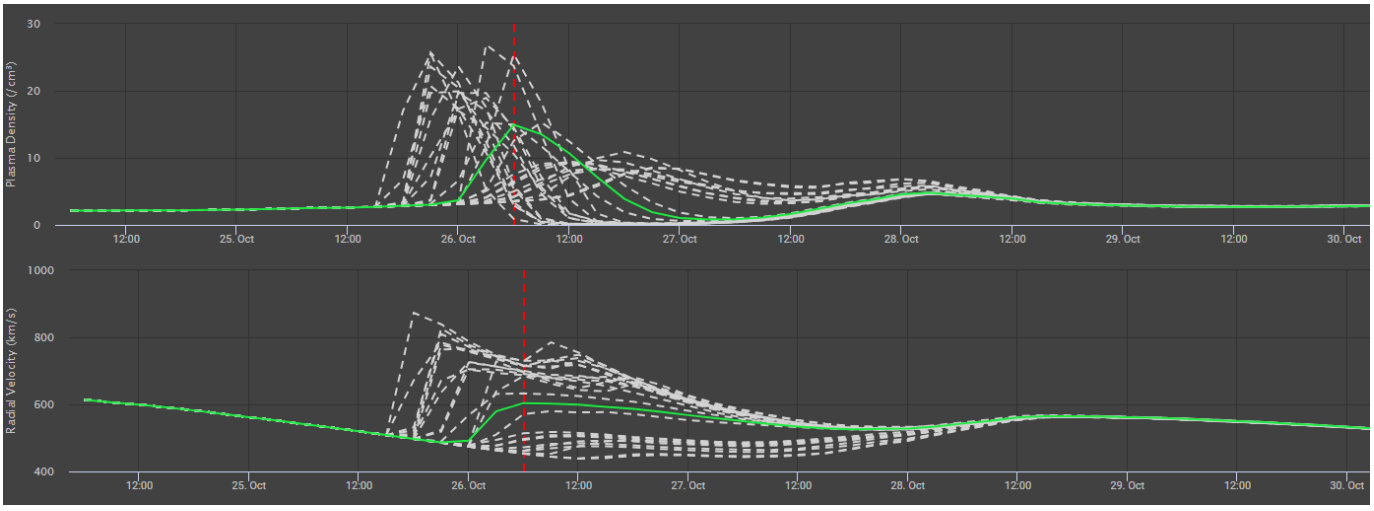
Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R⊙ (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed (km/s)	Estimated Arrival Time (UTC)	Comments
2024-10-24 06:21	Partial	X3.3 flare (AR3869)	SE	1383	26/0700 UTC	Moderate confidence in glancing arrival. -7/+10 hours.

Figure 2: Latest MOSWOC ENLIL Ensemble output. Note the broad spectrum of potential CME arrival times. ENLIl background winds also significantly too high ahead of predicted CME arrival which reduces confidence in speeds significantly.



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Radio Blackouts - X-Ray Flares

Generally Moderate activity is forecast with occasional M-flares considered likely in the coming days given the number of sunspot regions and the growing complexity of the disk. With a continued slight chance of further isolated X-flares. These risks increased from raw sunspot classification values given the recent history of the southeast cluster, and significant flares are most probable from this region.

No significant sunspots are due to depart the disk during the period, while recurrence and far-side sounding imagery suggest only a muted signal for oncoming regions. Therefore the flare risk is kept steady through the period pending further developments.

X-Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**R1-R2 (M Class)**	Yes	70	70	70	70
Very Active	**R3-R5 (X Class)**	Yes	20	20	20	20

Figure 3: Latest 24hr GOES16/18 X-ray trace, with the recent long period, multi-part X-flare continuing to decline.

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Solar Radiation Storms (High Energy Protons)

High energy proton flux at GOES-18 is forecast to remain at generally Background levels, although some slight proton enhancement is possible should further significant flares occur. The current most active regions are located near the east limb, but will gradually transit toward centre disc by the end of the period allowing for a slightly greater risk of proton enhancements.

Radiation Storms Probability (Exceedance)	Level ($cm^{-2}sr^{-1}s^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	10	10	10	15
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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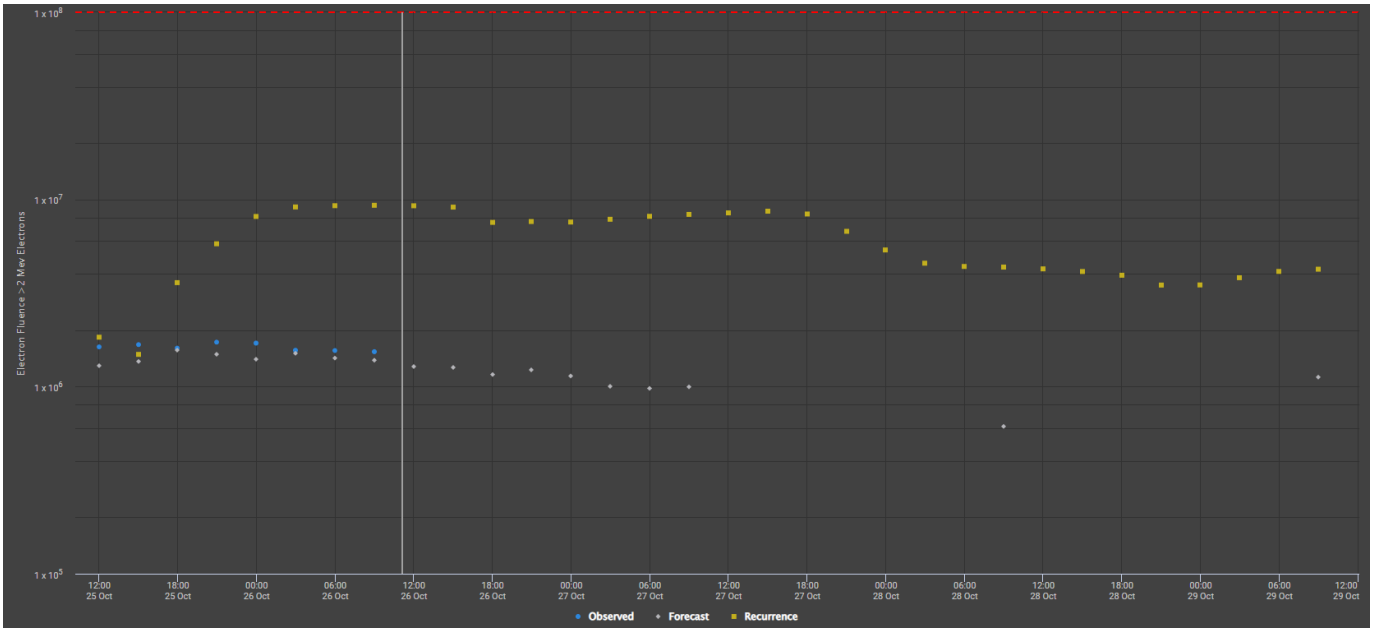
High Energy Electrons (≥ 2MeV)

High energy electron flux (greater than 2MeV) as observed by GOES16 is currently at Background levels, and is expected to persist mainly at this level with no significant enhancements expected.

The associated 24-hour fluence is currently expected to remain well below Active throughout the period, with the MOSWOC REFM forecast though to be providing good guidance.

GEO Electron Environment	Level ($cm^{-2}sr^{-1}$ day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ 1×10^{8}	No	1	1	1	1
Very Active	≥ 2 MeV ≥ 1×10^{9}	No	1	1	1	1

Figure 4: Latest MOSWOC REFM model output.



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